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(54) Abstract Title
Audio Dubbing System

(57) A dubbing system 8 for transferring audio data from an optical storage medium to solid state memory 5. The system comprises: a CD or DVD-ROM drive 1 for extracting audio data from at least one CD/DVD 7 which may be engaged with the dubbing system, in use of the system; compression encoder(s) 3 for compressing the extracted audio data; and transfer software and interfaces 4 for transferring the compressed audio data to a discrete removable solid state memory device 5 (e.g. memory card or a player unit) which may be engaged with the dubbing system, in use of the system. The CD/DVD-ROM drive, encoder and transfer software and interface are all provided together in a single unit 8. The invention thus provides a stand-alone unit 8 which carries out all the necessary functions to achieve the data transfer.

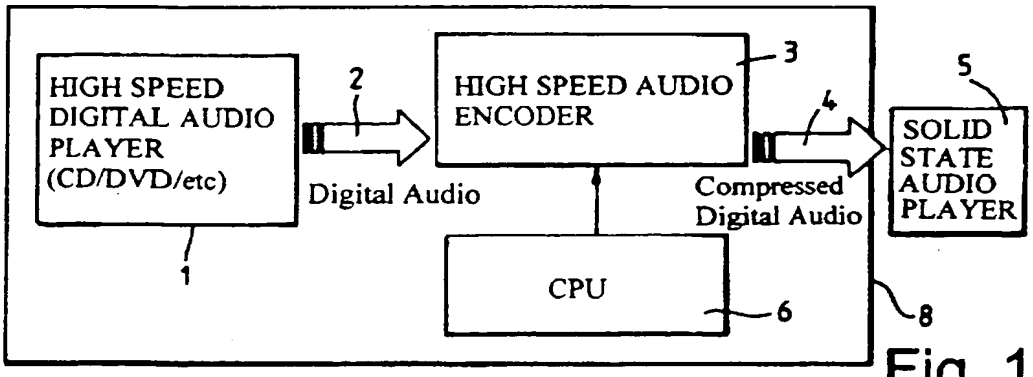

Fig. 1

GB 2 343 986 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

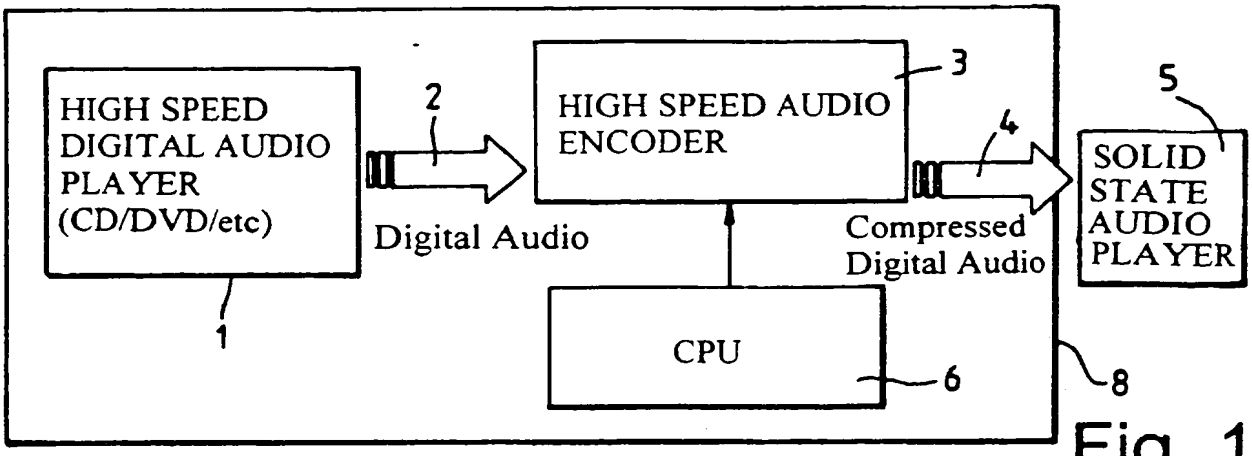
HIGH SPEED DIGITAL AUDIO PLAYER (CD/DVD/etc)
1
2
Digital Audio
HIGH SPEED AUDIO ENCODER
3
4
Compressed Digital Audio
5
SOLID STATE AUDIO PLAYER
CPU
6
8

Fig. 1

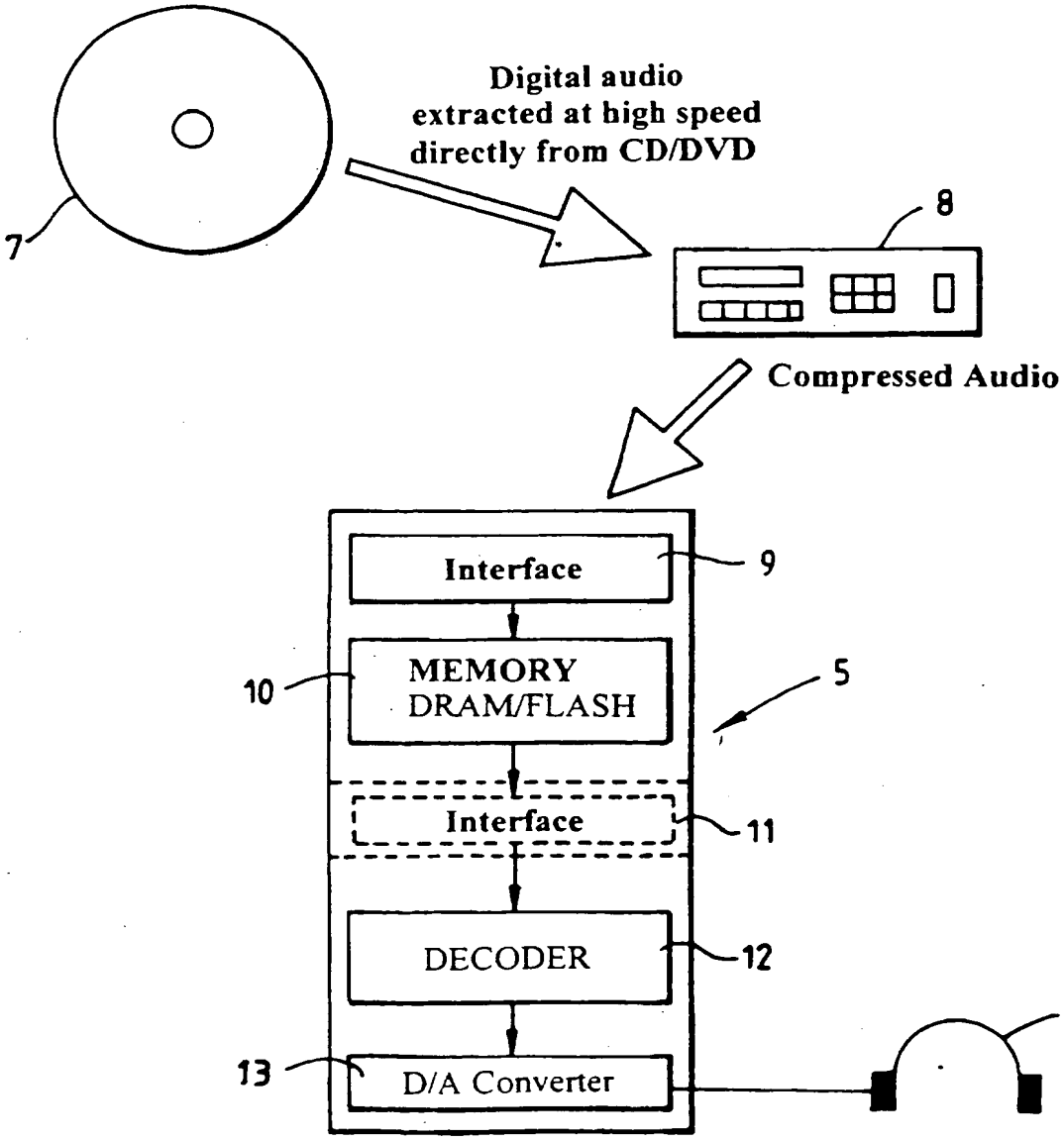
Digital audio extracted at high speed directly from CD/DVD
7
8
Compressed Audio
Interface
9
MEMORY DRAM/FLASH
10
5
Interface
11
DECODER
12
D/A Converter
13
14

Fig. 2

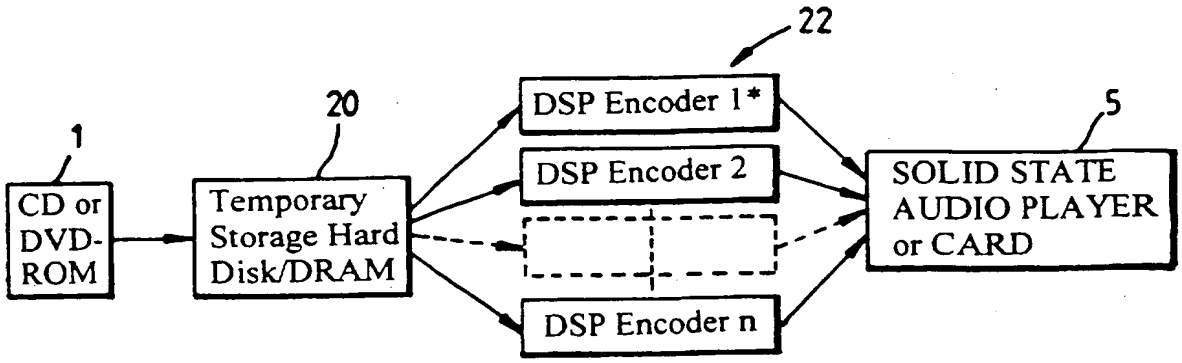

Fig. 3

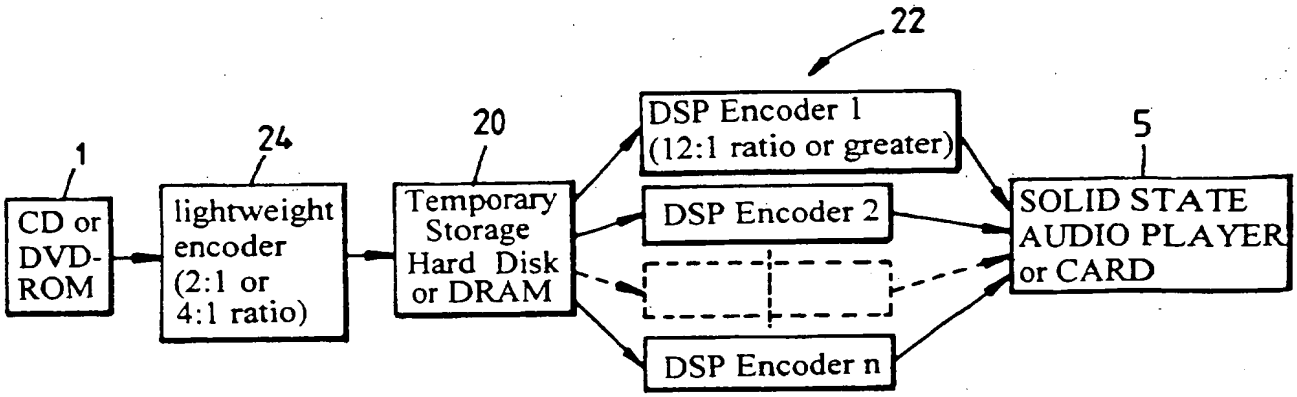

Fig. 4

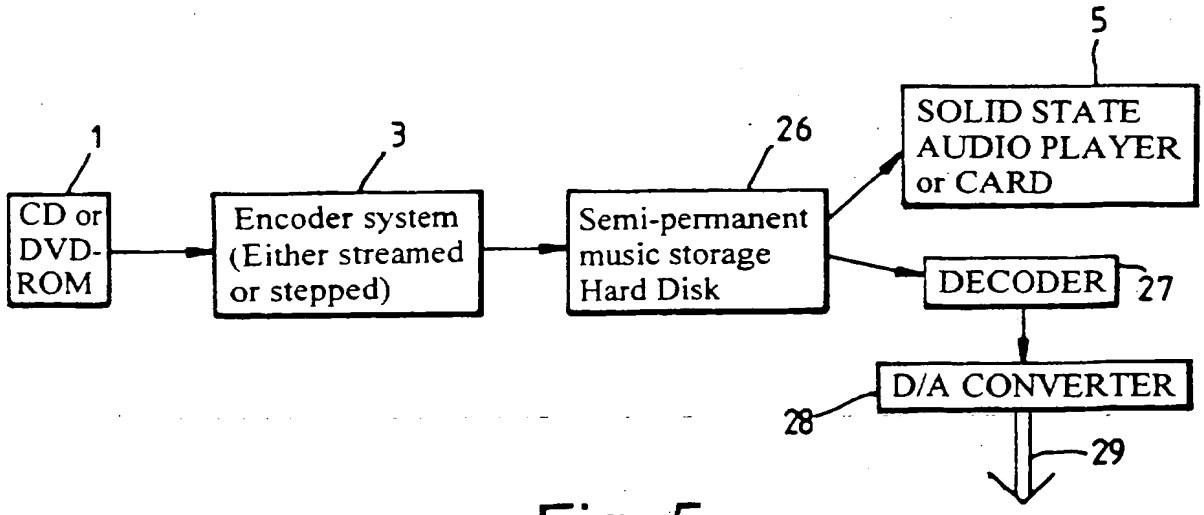

Fig. 5

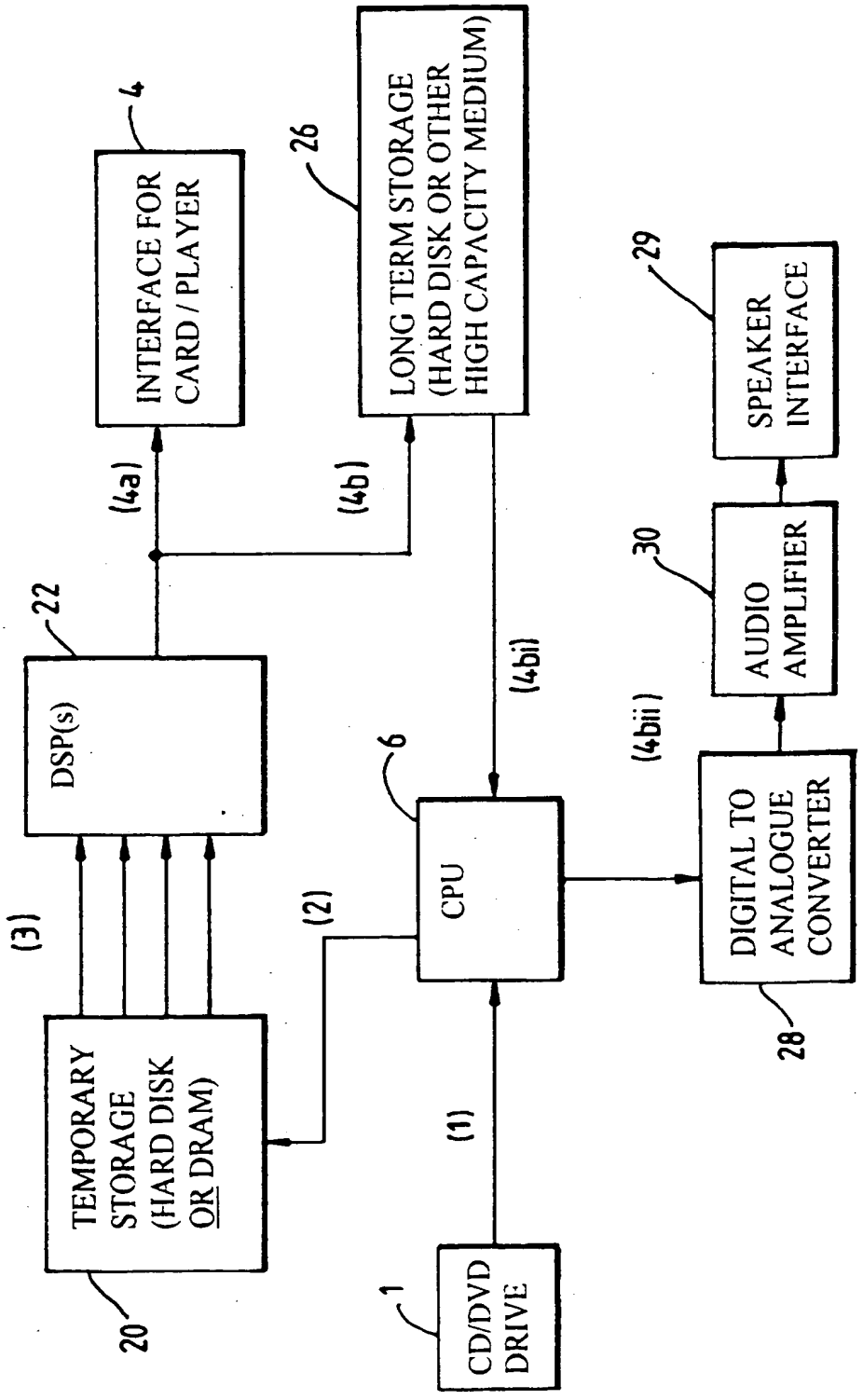
INTERFACE FOR CARD / PLAYER
4
LONG TERM STORAGE (HARD DISK OR OTHER HIGH CAPACITY MEDIUM)
26
SPEAKER INTERFACE
29
(4a)
(4b)
AUDIO AMPLIFIER
30
DSP(s)
22
(4bi)
6
(4bii)
(3)
(2)
CPU
DIGITAL TO ANALOGUE CONVERTER
TEMPORARY STORAGE (HARD DISK OR DRAM)
(1)
28
20
1
CD/DVD DRIVE

Fig. 6

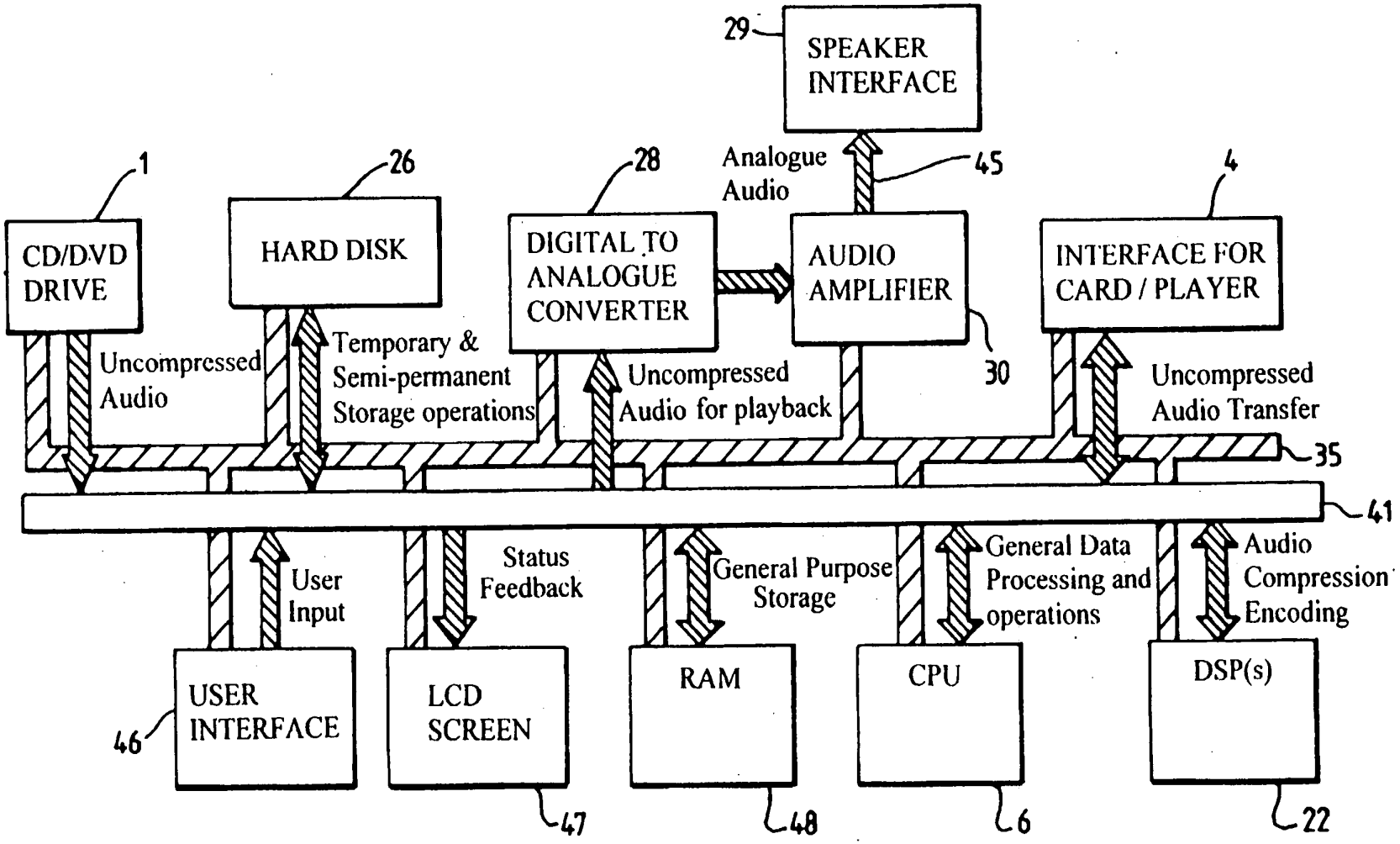
29
SPEAKER INTERFACE
Analogue Audio
45
1
CD/DVD DRIVE
26
HARD DISK
28
DIGITAL TO ANALOGUE CONVERTER
AUDIO AMPLIFIER
30
4
INTERFACE FOR CARD / PLAYER
Uncompressed Audio
Temporary & Semi-permanent Storage operations
Uncompressed Audio for playback
Uncompressed Audio Transfer
35
41
User Input
Status Feedback
General Purpose Storage
General Data Processing and operations
Audio Compression Encoding
USER INTERFACE
46
LCD SCREEN
47
RAM
48
CPU
6
DSP(s)
22
Control / Address pathways
Data path
Data flow

Fig. 7

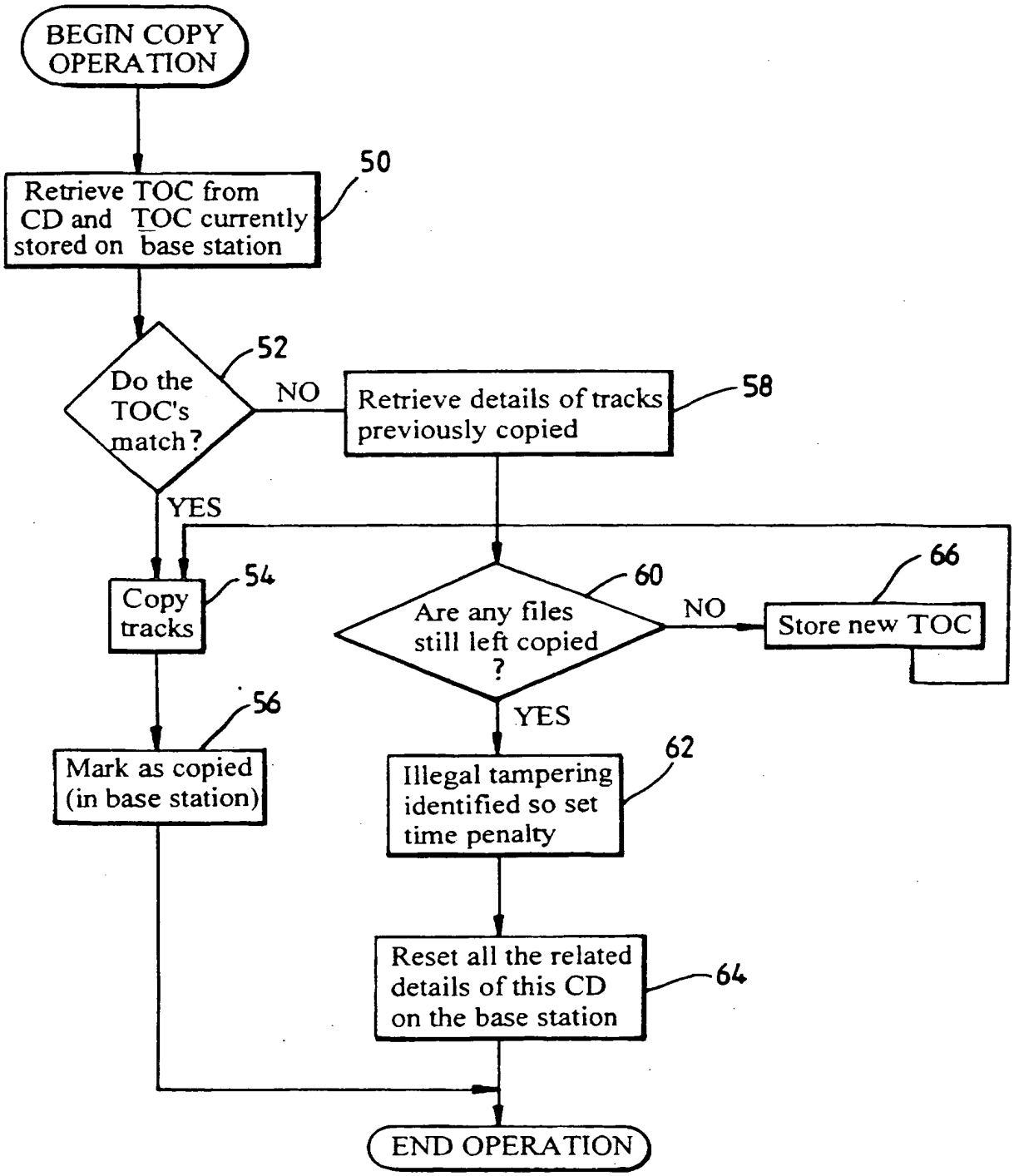
BEGIN COPY OPERATION
Retrieve TOC from CD and TOC currently stored on base station
50
Do the TOC's match?
52
NO
Retrieve details of tracks previously copied
58
YES
Copy tracks
54
Are any files still left copied ?
60
NO
Store new TOC
66
YES
Mark as copied (in base station)
56
Illegal tampering identified so set time penalty
62
Reset all the related details of this CD on the base station
64
END OPERATION

Fig. 8

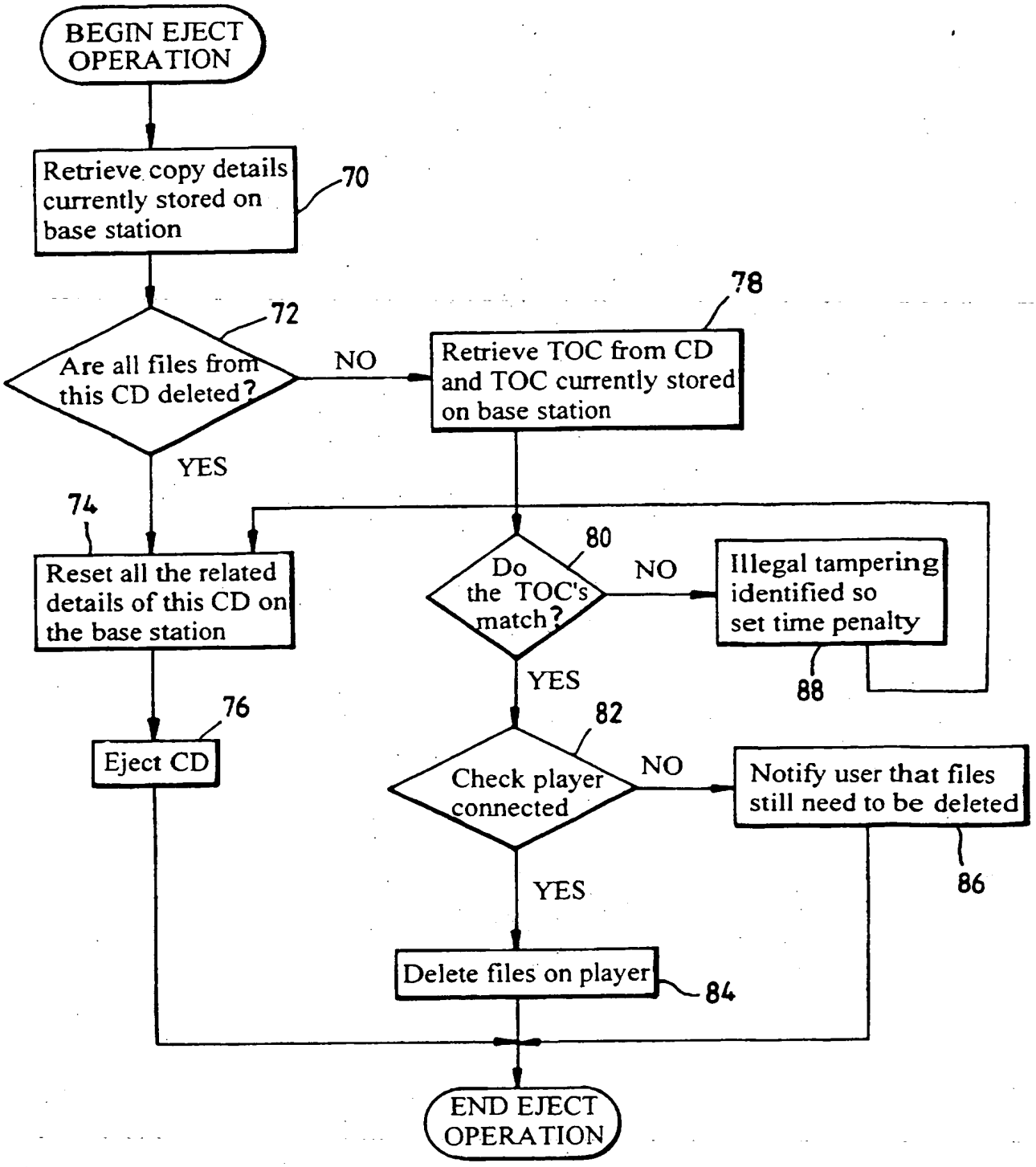
BEGIN EJECT OPERATION
Retrieve copy details currently stored on base station
70
Are all files from this CD deleted?
72
NO
Retrieve TOC from CD and TOC currently stored on base station
78
YES
74
Reset all the related details of this CD on the base station
Do the TOC's match?
80
NO
Illegal tampering identified so set time penalty
88
YES
76
Eject CD
Check player connected
82
NO
Notify user that files still need to be deleted
86
YES
Delete files on player
84
END EJECT OPERATION

Fig. 9

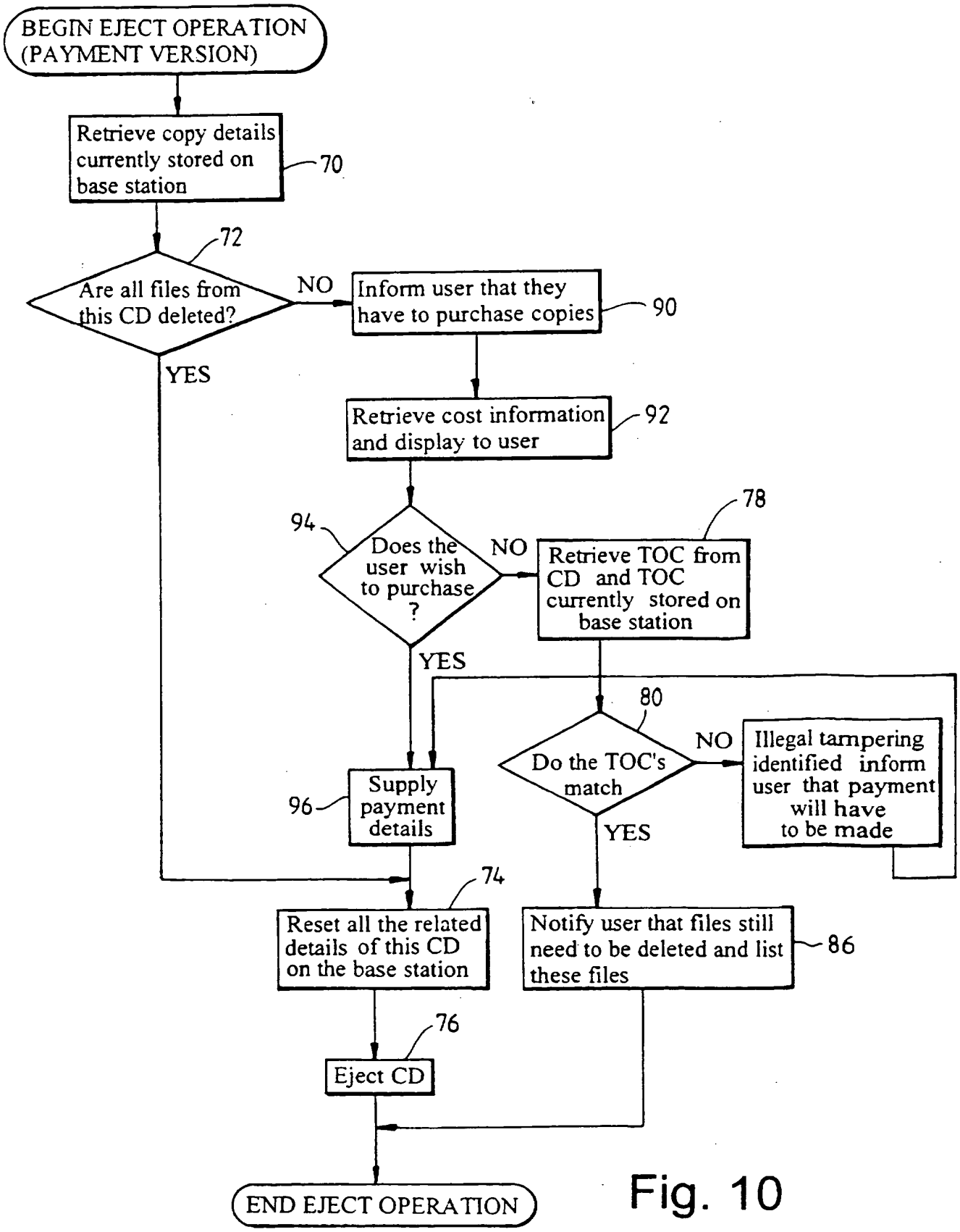
BEGIN EJECT OPERATION (PAYMENT VERSION)
Retrieve copy details currently stored on base station
70
72
Are all files from this CD deleted?
NO
Inform user that they have to purchase copies
90
YES
Retrieve cost information and display to user
92
94
Does the user wish to purchase ?
NO
78
Retrieve TOC from CD and TOC currently stored on base station
YES
80
Do the TOC's match
NO
Illegal tampering identified inform user that payment will have to be made
YES
96
Supply payment details
74
Reset all the related details of this CD on the base station
Notify user that files still need to be deleted and list these files
86
76
Eject CD
END EJECT OPERATION

Fig. 10

AUDIO DUBBING SYSTEM

The present invention relates to a consumer electronics system and, in particular, to a new audio dubbing system for transferring audio data from an optical storage medium to a portable solid state audio player, at speeds faster than real time.

Personal computer (PC) systems are currently available which enable a user to download audio data from an optical storage medium, such as a Compact Disc (CD), onto the hard disk drive of the PC in compressed form. Suitable compression software must be installed in the PC to carry out the compression operation. A portable solid state audio device is also known to be available (the "mpman" system marketed by Saehan Information Systems Inc. Of Korea) which is supplied with a dedicated interfacing device for connection between the portable device and a PC system, so as to enable a user to transfer compressed audio data from the PC system to solid state memory provided in the portable device. The portable device is disconnectable from the interfacing means to allow a user to playback the audio data at a remote location using the portable audio device, which includes decompression means for decompressing the stored data into a form suitable for a user to listen to. One attraction of such a portable solid state memory audio player is that they offer an extremely shock resistant portable audio format.

A disadvantage of such a system is that the user must have a PC system with a CD-ROM drive, in which system the necessary compression software has also been installed, as well as the separate interfacing device, in order to download music from his/her own music collection onto the portable solid state memory device. The data transferred from the CD must also first be stored in the hard disk(s) of the PC system, before being compressed and then transferred to the solid state

memory of the portable device. A further problem is that CD-ROM drives provided in computer systems are often not specifically designed for high-speed download of audio data.

According to a first aspect of the invention we provide a dubbing system for transferring audio data from an optical storage medium to solid state memory, the dubbing system comprising: audio data extraction means for extracting audio data from at least one optical storage disk which may be engaged with the dubbing system, in use of the system; data compression means for compressing the extracted audio data; and data transfer means for transferring the compressed audio data to a discrete removable solid state memory means which may be engaged with the dubbing system, in use of the system, and wherein said data extraction means, data compression means and data transfer means are all provided together in a single unit.

One advantage of the invention is that a user no longer requires a personal computer (PC) and additional software and dedicated interfacing equipment to carry out transfer of audio data from an optical storage medium to solid state memory. The present invention provides a stand-alone unit which carries out all the necessary functions to achieve the data transfer.

Preferably, the audio data extraction means, data compression means, and data transfer means are formed and arranged for extracting, compressing and transferring the data to the solid state memory means at faster than real-time speed. This enables a user to, for example, transfer the contents of a CD to the solid state memory means at greater than real time speed. Preferably, the audio data extraction means, data compression means, and data transfer means are formed and arranged for extracting, compressing and transferring the data to the solid state memory means at a rate of at least ten times real time. Such a high speed dubbing station has the advantage of allowing a user to quickly and easily transfer

songs from their personal music collection onto a portable format for listening as they would with other generic portable audio devices, with the added benefit of an extremely shock resistant portable audio format.

The data compression means preferably comprises compression encoder means which may conveniently comprise digital signal processor means such as, for example, one or more MPEG encoder systems. Alternatively, the dubbing system may include a central processing unit (CPU) which may provide the compression encoder means.

The audio data extraction means may be configured to send the extracted audio data directly to the data compression means, without first storing the extracted data, even temporarily, in a hard disk or other memory means.

Alternatively, the dubbing system may further include temporary storage means which may, for example, be volatile memory means (e.g. DRAM) or non-volatile memory means (e.g. one or more hard disks), and the audio data extraction means may be configured to store the extracted audio data in this temporary storage means. The data compression means may comprise a plurality of encoder means via which a plurality of sets of audio data may be compressed in parallel, each said data set being compressed by a respective one of said encoder means. Said plurality of encoder means may be provided in the form of a single compression encoder system having a plurality of data channels. Alternatively, said plurality of encoder systems may be provided as a plurality of separate compression encoders. The temporarily stored audio data may comprise a plurality of sets of data, for example a plurality of tracks from a music CD, and the processor means (where provided) may be programmed to transfer, preferably simultaneously, each said set of data to a respective said encoder means. This enables the plurality of encoder means to be used to, for example, carry out compression of various different music

tracks in parallel, thereby further increasing the compression rate of the whole dubbing system.

The dubbing system may, for example, be designed for transferring audio data from Compact Disc (CD) to solid state memory, in which case the audio data extraction means preferably comprises a CD-ROM drive. Alternatively, the system may be designed for transferring audio data from Digital Video/Versatile Disc (DVD) to solid state memory, in which case the audio data extraction means preferably comprises a DVD-ROM drive. The audio data extraction means may further include processing means, which may conveniently be incorporated in a central processing unit (CPU) which may be provided in the dubbing system, programmed to control the data extraction, and first interface means for interfacing the CD-ROM or DVD-ROM drive with said CPU. The first interface means preferably comprises an UltraDMA interface. Such interfaces have the advantage of being able to handle burst transfer speeds of up to 33Mbytes per second.

The data transfer means preferably comprises second interface means, which may conveniently comprise a Universal Serial Bus (USB), for interfacing the removable solid state memory means with the data compression means. The data transfer means may also include transfer software for transferring the compression encoded data, via the USB, to the solid state memory means. The software may conveniently be stored, for example as firmware, in a memory means provided in the dubbing system (for example in the CPU).

The discrete removable solid state memory means may be provided as a discrete removable component of the dubbing system itself. The solid state memory means may comprise a portable audio player unit having solid state memory incorporated therein. Alternatively, the solid state memory means may comprise a removable memory card (for example a PCMCIA removable memory card or other portable memory device

of a standard type) which is formed and arranged for removable engagement with a portable audio player unit designed to accept such a card.

Where the dubbing system includes temporary storage means as above-described, for example DRAM or one or more hard disks, this storage means may have sufficient capacity for storage of, for example, a collection of compressed music tracks, which may be accessed at a later time by a user, for download to the removable solid state memory means. The dubbing system may further include data decompression means and audio playback means formed and arranged for enabling a user to playback (i.e. listen to) audio tracks which have been stored (in compressed form) on this storage means. The dubbing system may be provided with user interface means for enabling a user to select particular tracks for downloading from the optical disk(s) to the solid state memory means. Where the dubbing system includes a CPU, this user interfacing means may be provided, at least partly, in the CPU which may be programmed to allow a user to classify or index tracks which have been stored in the storage means of the system and subsequently recall particular tracks for playback according to their respective classifications/indices.

The dubbing system preferably further includes locking means formed and arranged for locking an optical storage disk in engagement with the dubbing system (for example locking a CD inside a CD-ROM drive of the dubbing system) until any audio data which has been copied from the optical storage disk to the removable solid state memory means has been deleted from the solid state memory means. Where the dubbing system is designed to engage with more than one optical storage disk at any one time, for example to allow downloading of audio data from two or more disks, perhaps simultaneously, the locking means is preferably formed and arranged to lock each said disk individually in engagement with the dubbing station, whereby each disk may be unlocked separately if any audio data which

has been copied from that disk to the removable solid state memory means has been deleted from the solid state memory means. The locking means therefore provides a copy management function for controlling unauthorised copying of audio data from an optical storage device such as a CD or DVD. Locking and unlocking of the locking means may conveniently be controlled by a processor means of the dubbing system, for example the CPU (where provided), which may be programmed to verify if audio data copied onto the solid state memory means from a said optical storage disk has been deleted from the solid state memory means. It will be appreciated therefore that the dubbing station preferably includes deletion means for enabling a user to delete data stored in the solid state memory means.

The dubbing system may further include additional interfacing means formed and arranged for enabling the system to receive audio data, already in compressed format, from an external source such as, for example, a "set-top box" unit. This would allow a user to, for example, purchase compressed audio data from a supplier, for example via the Internet. The purchased music can then be transferred to the removable solid state memory means using the dubbing system.

Preferred embodiments of the invention will now be described, by way of example only, and with reference to the accompanying drawings in which:

Fig.1 is a block diagram illustrating a dubbing system according to the invention;

Fig.2 is a schematic diagram illustrating a high speed dubbing system according to one embodiment of the invention;

Fig.3 is a block diagram illustrating an embodiment of the invention incorporating parallel data compression;

Fig.4 is a block diagram illustrating a modified version of the system of Fig.3;

Fig.5 is a block diagram illustrating a dubbing system according to another embodiment of the invention;

Fig.6 is a block diagram illustrating date flow in the dubbing system of Fig. 5;

Fig.7 is a further block diagram illustrating control address pathways, data paths, and data flow in the dubbing system of Fig.5;

Fig.8 is a flow chart for a copying operation carried out in a dubbing system of the invention;

Fig.9 is a flow chart for a CD eject operating; and

Fig.10 is a flowchart for a modified CD eject operation involving a payment facility.

Fig.1 illustrates the basic operation of a dubbing station 8 according to one embodiment of the invention. (This embodiment will hereinafter be referred to as the "streamed serial encoder" embodiment.) The system 8 incorporates a high speed digital audio player 1, which is a CD or a DVD-ROM drive which is used to extract digital audio data from the CD or DVD at a rate of at least 10 x real time, and in the preferred embodiment at 32 x real time, or at an even faster rate (possibly up to 45 x real time). A CPU 6 is provided in the dubbing station 8 and is programmed to control the extraction of the audio data from the CD/DVD, carrying out data buffering, audio frame synchronisation ("jitter correction") and perhaps "normalisation", as necessary and in generally known fashion. The extracted data is sent, via an ultraDMA interface 2, to an MPEG Layer-3 encoder 3 which uses compression encoding to compress the extracted audio data. The compressed audio data is transferred, using data transfer means 4 in the form of data transfer software (stored in non-volatile memory in the dubbing station 8 e.g. in the CPU 6) and a suitable interface, for example a USB or Compact Flash interface, to an audio player device 5 which is a discrete component, removable from the dubbing system, but which may be interfaced thereto (via the USB) in order to receive data from the dubbing system 8. The player 5 contains solid state memory, conveniently in the form of FLASH memory, in which the downloaded compressed audio data is stored. The player device

also contains compressed data decoder means for decompressing the stored data, and playback means for allowing a user to playback the stored audio data at a remote location from the dubbing system e.g. while the user is out jogging.

It will be appreciated that the speed at which the CD-ROM drive 1 extracts the audio data is important as this has a substantial influence on the overall speed of data transfer in the dubbing station 8. As CD Digital Audio plays back at a rate of approx. 172Kbytes/second, in order to achieve a data extraction rate of at least 10 x real time (approx.), the CD-ROM drive must have an access speed of at least 1.7Mbytes/second.

The data input rate of the encoder 3 is also chosen to at least match the access rate (i.e. data extraction rate) of the C-ROM drive 1. Since the CD-ROM access rate is at least 10 x real time, the data input rate of the encoder 3 must therefore be at least 1.7Mbytes/second. The MPEG layer 3 encoder compresses the data by a ration of approximately 12:1, resulting in a data output rate from the encoder 3 of approx. 160Kbytes/second. The USB or Compact Flash interface 4 between the encoder 3 and player device 5 must therefore be capable of at least the same data transfer speed (i.e. at least 160Kbytes/second) in order that the encoder output rate is not limited by this interface.

The data transfer between the CD-ROM or DVD-ROM drive 1 and the compression encoder 3, and between the encoder 3 and the solid state memory device (player 5), is controlled by the CPU 6 of the dubbing system. The CPU may also be configured/programmed to control the operation of the MPEG Layer-3 encoder 3, or may as already mentioned be configured/programmed to carry out the encoding itself. Where the CPU is to be used to carry out MPEG Layer 3 encoding, in the embodiment described with reference to Fig.1 (the streamed

serial encoder embodiment), the CPU needs to be a fast processor, typically a top-of-the-range Pentium processor or its equivalent. Where the CPU 6 is used only to control operations in the dubbing station and to handle some data transfer, and a separate encoder 3 is used, a slower processor may be used.

By using a CD-ROM drive, encoder, and interfaces as above-described a home user can thus achieve high speed recording i.e. at least 10 x real time recording using the dubbing station 8. This means that an average CD of approx. 50 minutes playing time will be copied to the solid state memory of the player device 5 in under 5 minutes.

In a modified version of the above-described system, the dubbing station is designed to download the compressed audio data directly onto a removable memory card 5, for example a portable FLASH memory card conforming to PCMCIA specifications, which card may then be removed and inserted into a portable audio player device designed for receiving such a card and decompressing and playing back audio data stored thereon.

The portable audio player (or removable memory card) 5 may be provided together with the dubbing system as a discrete separate component thereof, or could be purchased separately. Where provided as part of the dubbing system, the solid state memory chosen to be used in the portable player (or card) 5 is preferably relatively "fast" FLASH or DRAM which may be written to at a rate of up to 250kbytes/second or more.

Fig.2 illustrates in more detail the function of the dubbing system, in downloading audio data to a portable audio device. Fig.2 shows a CD 7, which has music recorded thereon, which is inserted into the dubbing station 8 described with reference to Fig.1, (incorporating the CD-ROM drive 1, ultraDMA

interface 2, compression encoder 3, CPU 6 and data transfer means 4) and which is connected to a portable audio player device 5. As shown in Fig.2, the player device 5 comprises: an interface 9 which interfaces with the USB interface 4 of the dubbing station; the FLASH or DRAM memory 10 for storing the compressed audio data; a further interface 11 between the FLASH/DRAM and a decoder 12 for decompressing the compression encoded data; and a D/A converter 13 for converting the decoded digital data back to analogue (user listenable) form. The user may listen to music stored on the memory 10 via headphones 14 connected to the portable player 5.

In use of the dubbing system described with reference to Fig.1, the data extracted from the CD (or DVD) 7 is sent directly to the MPEG encoder 3, which compresses the data and sends the compressed data directly (via the data transfer means 4) to the solid state memory device (player or card) 5. Thus, music tracks downloaded from the CD/DVD are streamed directly to the solid state memory, without having to store a complete copy of the music until it reaches the player or card 5.

Fig. 3 illustrates a modified embodiment of the dubbing system which incorporates at least one hard disk, or DRAM temporary storage, 20 on which audio data extracted from the CD/DVD is first stored temporarily, before the compression encoding is carried out. (The CPU 6 is not shown in Fig.3, but carries out a similar function as in the system illustrated in Fig.1.) This embodiment will be referred to as the "parallel" or "stepped" encoding embodiment. In this embodiment, the encoder means comprises two or more DSP encoders 22 (shown in Fig.3 as DSP encoders 1,2..n). Several music tracks stored on the hard disk or DRAM 20 are transferred to the DSPs, one track to each respective encoder. This enables up to n tracks to be compressed in parallel. The recording speed of the dubbing station is controlled by the number, and compression ratios, of the DSP encoders 22. Thus, if each DSP encoder 22 carries

out 1 x real time encoding, we need ten such encoders to match a CD-ROM output rate of 10 x real time. Where faster DSPs are used, the number of such encoders would be reduced (e.g. 2 x encoders, need only five of these). The audio data temporarily stored in the hard disk or DRAM 20 is subsequently overwritten by new incoming audio data extracted from a CD/DVD in the CD/DVD-ROM drive.

The system of Fig.3 can be modified, as shown in Fig.4, to incorporate a preliminary "lightweight" encoder 24, which may be incorporated in the CPU 6 or which may be a single DSP encoder. This preliminary encoder is designed to carry out less power intensive compression, at a speed generally matching the speed of the audio data extraction from the CD or DVD, for example at 2:1 or 4:1 time compression, prior to storing the data temporarily on the hard disk(s) or DRAM 20. Several DSP encoders, having compression rates of 12:1 or greater, may then be used to further compress the data before downloading it to the player/card 5.

Instead of downloading the output of the encoders directly to the player/card 5, according to another possible embodiment which is illustrated in Fig.5, the compressed data may be stored in a memory 26 provided in the dubbing system for this purpose. In the embodiment of Fig.5 this memory is a hard disk. The CPU operating system includes user interface software for enabling a user to identify particular music sections, e.g. particular individual tracks, stored in the memory 26. The tracks could be identified by using data stored on the CD (e.g. a track ID number stored on the CD) or by a classification/index. The dubbing system also incorporates at least one decoder 27 for decompressing the stored, encoded audio data, a D/A converter 28 for converting the decompressed data back to analogue form, and an output 29 for connection to audio output means, e.g. speakers or headphones. The user interface is configured to enable a user to select particular tracks for playback, using the corresponding track

indices/classifications given thereto. For example, users could selectively playback a desired collection of music of a particular type e.g. classical, rock, easy listening, "Mum's favourites" etc.

The user interface may also be configured to allow a user to store compressed audio data in the memory 26 for later download to a portable player device (or removable memory card).

The data flow between the various components of the dubbing station according to Fig.5, incorporating the "parallel" encoding technique, is illustrated in more detail in the block diagram of Fig.6. The sequence of data flow events illustrated in Fig.6 will be described with reference to operation of the system as follows:

(1) Digital Audio data is extracted from a CD or DVD (in the CD or DVD-ROM drive 1) by the CPU 6;

(2) Processed digital audio is transferred onto a temporary storage medium such as a hard disk or DRAM 20. The processed audio may firstly be lightly compressed by the CPU 6;

(3) As soon as data is available on the temporary storage medium 20 it can begin to be processed by a DSP encoder unit which carries out the parallel compression using a plurality of DSP encoders 22;

(4) As soon as the first DSP 22 is finished with the first pieces of data, these are sent either to:

a. An interface 4 in which the memory card or portable audio player device 5 is connected, OR

b. A semi-permanent storage device such as a hard disk 26, from which:

(i) The compressed audio tracks are extracted by the CPU 6 and decoded (decompressed) (either by the CPU itself, if it is powerful enough, or by one or more separate DSP decoders provided in the dubbing station 8), and

(ii) the decompressed audio tracks are sent to a digital to analogue converter 28 and from there to an audio

amplifier 30 and speaker interface (output 29) connected thereto.

Where the streamed serial encoder embodiment is used, step (2) is not required, the encoding (i.e. compression) being carried out directly by the CPU or by a separate DSP encoder.

Fig.7 illustrates in further detail the control address pathways (shown in bold line, numbered 35), data path (unfilled block line, numbered 40), and individual data flow operations (shown as striped arrows 45) between the components of the dubbing station according to Fig.6. Fig.7 also shows modules representing a user interface 46, LCD screen 47 and general purpose storage RAM 48 which would preferably also be included in the system. The user interface 46 would enable a user to input commands/requests, and/or choose options for the dubbing station to carry out, which would be displayed on the LCD screen 47.

The dubbing system is also provided with a copy management feature to prevent, at least to some extent, unauthorised copying of original CDs/DVDs onto the solid state memory device. This is achieved by including an electronically controlled locking arrangement in the CD-ROM drive which prevents a CD engaged in the drive from being disengaged until the contents of the solid state memory in the player 5 have been deleted. In the present embodiment, the CPU 6 of the dubbing system is programmed to entirely carry out the function of the locking means by appropriately controlling the CD-engaging mechanism (of conventional type) in the CD-ROM drive. (Alternatively, the CPU could be programmed to control the locking unlocking of an actual physical locking arrangement which could be incorporated in the CD-ROM drive.) The user interface is configured to allow a user to select to delete the contents of the solid state memory of the player 5 (or card), after use thereof. When a user wishes to eject the

CD from the dubbing unit, the player 5 (or card) must be engaged with the unit, as if to receive downloaded audio data. The CPU is programmed so that, upon receipt of a user command to eject the disk, the CPU checks that the contents of the solid state memory have been deleted and, if the contents have been deleted, issues a verification signal which allows the CD to be ejected from the CD-ROM drive. Otherwise, the CPU effectively locks the CD in the CD-ROM drive by not allowing the CD to be ejected.

This verification process may, if desired, involve some signal encryption in order to try to circumvent unauthorised removal of CDs from the dubbing unit by the use of fake verification signals. Alternatively, the CPU may be programmed to also compare the Table of Contents (TOC) of the CD with corresponding TOC data which is stored in the base station when data is copied from a CD using the base station. If the TOC data does not match, the base station identifies that illegal tampering has taken place and sets a time penalty during which the base station cannot be used to carry out any further copying.

The operation of this locking arrangement, and the detection of illegal tampering using TOC data, in conjunction with the copying of audio data using the base station, is illustrated in further detail in the flow charts of Figs.8, 9 & 10. Fig.8 is a flow chart illustrating the main steps carried out during a copying operation. When a user makes a request to the dubbing station (via the user interface) to copy data from a CD (or DVD) the CPU 6 retrieves the TOC from the CD and the TOC currently stored (if any) in the base station (block 50) and compares them (block 52). If the TOCs so retrieved match then the CPU allows copying from the CD to take place 54. The tracks which are copied are marked 56 as copied, in the base station (e.g. in a memory thereof). If the TOCs do not match (this will include the case where no TOC is retrieved from the

dubbing station), the CPU retrieves from dubbing station memory the details of tracks previously copied 58. If there are still any data files marked as copied 60 then the CPU identifies that illegal tampering has taken place 62 and sets a time penalty. The time penalty is set by means of a clock/counter arrangement provided in the dubbing station which prevents further copying being carried out within a predetermined period (e.g. 24 hours) using the dubbing station. All the details stored in the dubbing station relating to this particular CD are subsequently reset 64 (i.e. all details as to copied tracks). If, at block 60, no stored tracks are identified as having been previously copied, then the TOC for the present CD is stored 66 in the dubbing station and copying of the desired tracks is allowed to take place 54.

Fig.9 illustrates the various steps carried out when a user request a CD engaged in the dubbing station to be ejected. Upon receiving the CD ejection request, the CPU 6 retrieves from the base station memory details of any tracks which have been copied 70. If no tracks are marked as copied (i.e. everything has been deleted from the memory of the portable player or removable card 5) 72 then reset all the related details of this CD on the base station (i.e. delete stored TOC for this CD) 74 and eject the CD 76. If there are still tracks marked as copied, then retrieve the TOC for this CD and the TOC currently stored in the dubbing station 78. If the retrieved TOCs match 80, check 82 that the player/card 5 is connected to the dubbing station, and if it is connected then delete 84 the files stored in the player/card 5. If the player/card is not connected, then notify the user 86 (via user interface) that files still need to be deleted, and do not allow ejection of the CD. If the TOCs do not match, identify that illegal tampering has taken place 88 and set time penalty as described above. At end of time penalty, reset all stored details 74 relating to this CD in the dubbing station, and allow ejection 76 of the CD.

In the event of a player or card 5 containing tracks which have been downloaded from an original CD, using the dubbing unit, being lost, stolen or failing, thereby making it impossible for the user to delete tracks copied thereto and thus update the "copied" status of tracks as stored in the dubbing station, the CPU will (upon a copying request or ejection request as above-described) identify an illegal tampering situation to have occurred and the time penalty will be set. On ending of the penalty period a user will again be able to use the dubbing station to copy, or be able t remove a CD engaged therein.

Although most CD-ROM drives allow a user to eject a CD inserted therein by simply pressing an ejection button provided on the drive, in the present invention this button (if present) will not be available to a user. This button, or at least its function, will be tied into the above-described copy protection scheme to prevent a CD being ejected if there is still copied material in the solid state memory of the player device or card 5.

It will be appreciated that variations and modifications to the above-described embodiments are possible without departing from the scope of the invention. For example, instead of an UltraDMA interface 2, a PIO Mode4 or SCSI interface could be used for the interface 2, if preferred. Also, instead of a MPEG Layer-3 encoder, an AAC encoder or other similar perceptual audio encoding software and/or hardware could be used as the compression encoder 3.

Furthermore, it is envisaged that extra protection of data downloaded from original optical disks to the solid state memory device using the dubbing station could be achieved by incorporating data encryption means in the dubbing station for encrypting the data extracted from the optical disk(s), either

after or simultaneously with, the data compression. In this case, the portable audio player used with the system would be provided with appropriate decryption means, as well as decompression means.

In a further possible modification of the above-described systems, the dubbing station may also include a further interface for interfacing the system to a network, to enable the system to receive data from, for example Digital Television Cable network or from the Internet. This interface would enable the compression encoder(s) 3 to receive audio data for compression, from the network. Alternatively, or additionally, the interface would allow already compressed audio data to be received by the dubbing unit and downloaded onto the solid state memory of the portable player or card 5. In this embodiment the above-described copy management function implemented by the CPU 6 would be further adapted to allow a user to purchase further permanent copies of music from a CD which the user already owns. Negotiation would be handled automatically over the network using established (known) encrypted payment methods. When a user has signalled a wish to purchase a further permanent copy of a track or tracks from a CD which is engaged in the dubbing unit (using the user interface), payment is effected over the network (via negotiation between the CPU 6 and the network) using the encrypted payment method, and, once purchased, the CPU issues the verification signal to allows the CD to be released from the dubbing unit, without the user having had to delete the contents of the solid state memory of the player or card 5.

Fig.10 illustrates the steps carried out during an ejection operation in the above-described embodiment where a payment facility is provided for the user to purchase tracks over a network. This is a modified version of the process illustrated in Fig.9 and like reference numerals are used to denote like processing steps. The main modifications are that at step 80, if all the files from the presently inserted CD have not been

deleted, the user is informed 90 (via user interface) that they need to purchase copies. Relevant cost information is retrieved 92 and displayed to the user who is given the option 94 to purchase. If the user indicates he does not wish to purchase, the CPU retrieves the TOC from the CD and the TOC stored in the dubbing station 78 and compares these 80. If these do not match, illegal tampering is identified and the user is informed to make payment. After payment is made 96, all stored details regarding this CD are reset in the dubbing station 74 and ejection is allowed 76. If, at step 94, the user indicates a wish to purchase and payment details are supplied 96, again all stored details of this CD are reset and the CD is ejected.

CLAIMS

1. A dubbing system (8) for transferring audio data from an optical storage medium to solid state memory, the dubbing system comprising: audio data extraction means (1, 6) for extracting audio data from at least one optical storage disk which may be engaged with the dubbing system, in use of the system; data compression means (3) for compressing the extracted audio data; and data transfer means (4) for transferring the compressed audio data to a discrete removable solid state memory means (5) which may be engaged with the dubbing system, in use of the system, and wherein said data extraction means, data compression means and data transfer means are all provided together in a single unit (8).

2. A dubbing system according to claim 1, wherein the audio data extraction means, data compression means, and data transfer means are formed and arranged for extracting, compressing and transferring the data to the solid state memory means (5) at faster than real-time speed.

3. A dubbing system according to claim 2, wherein the audio data extraction means, data compression means, and data transfer means are formed and arranged for extracting, compressing and transferring the data to the solid state memory means (5) at a rate of at least ten times real time.

4. A dubbing system according to any preceding claim, wherein the data compression means comprises at least one MPEG encoder (3).

5. A dubbing system according to any of claims 1 to 3, wherein the data compression means comprises a central processing unit (CPU).

6. A dubbing system according to any preceding claim, wherein the audio data extraction means is configured to send the extracted audio data directly to the data compression means (3).

7. A dubbing system according to any of claims 1 to 6, wherein the dubbing system further includes memory means (20) and the audio data extraction means is configured to store, at least temporarily, the extracted audio data in said memory means.

8. A dubbing system according to any preceding claim, wherein the data compression means comprises a plurality of encoder means via which a plurality of sets of audio data are compressed in parallel, in use of the system, each said data set being compressed by a respective one of said encoder means.

9. A dubbing system according to claim 8, wherein said plurality of encoder means are provided in the form of a single compression encoder system (3) having a plurality of data channels.

10. A dubbing system according to claim 8, wherein said plurality of encoder systems are provided as a plurality of separate compression encoders (22).

11. A dubbing system according to any of claims 8 to 10, wherein the at least temporarily stored audio data comprises a plurality of sets of data and the system further includes processor means (6) programmed to transfer substantially simultaneously each said set of data to a respective said encoder means.

12. A dubbing system according to any preceding claim, wherein the system is adapted to transfer audio data from Compact Disc (CD) (7) to the removable solid state memory

means, and the audio data extraction means comprises a CD-ROM drive (1).

13. A dubbing system according to any of claims 1 to 11, wherein the system is adapted to transfer audio data from Digital Video/Versatile Disc (DVD) (7) to the removable solid state memory means (5), and the audio data extraction means comprises a DVD-ROM drive (1).

14. A dubbing system according to claim 12 or claim 13, wherein the audio data extraction means further includes: processing means incorporated in a central processing unit (CPU 6) which is provided in the dubbing system, said processing means being programmed to control the data extraction; and first interface means for interfacing the CD-ROM/DVD-ROM drive with said CPU.

15. A dubbing system according to claim 14, wherein the first interface means comprises an UltraDMA interface.

16. A dubbing system according to any preceding claim, wherein the data transfer means (4) comprises second interface means in the form of a Universal Serial Bus (USB) for interfacing the removable solid state memory means (5) with the data compression means (3).

17. A dubbing system according to claim 16, wherein the data transfer means further includes transfer software for transferring the compression encoded data, via the USB, to the solid state memory means (5).

18. A dubbing system according to any preceding claim, wherein the discrete removable solid state memory means (5) is provided as a discrete removable component of the dubbing system.

19. A dubbing system according to any preceding claim, wherein the solid state memory means comprises a portable audio player unit (5) having solid state memory incorporated therein.

20. A dubbing system according to any of claim 1 to 18, wherein the solid state memory means (5) comprises a removable memory card which is formed and arranged for removable engagement with a portable audio player unit designed to accept such a card.

21. A dubbing system according to claim 7, wherein the dubbing system further includes data decompression means (27) and audio playback means (28, 29) formed and arranged for enabling a user to playback audio tracks which have been stored in compressed form in said memory means (20) of the dubbing system.

22. A dubbing system according to any preceding claim, wherein the dubbing system is provided with user interface means (46, 47) for enabling a user to select particular tracks for downloading from said at least one optical storage disk (7) to the solid state memory means (5).

23. A dubbing system according to any preceding claim, wherein the system further includes locking means (1, 6) formed and arranged for locking an optical storage disk (7) in engagement with the dubbing system until any audio data which has been copied from the optical storage disk to the removable solid state memory means (5) has been deleted from the solid state memory means (5).

24. A dubbing system according to claim 23, wherein the dubbing system is designed to engage with more than one optical storage disk at any one time and the locking means (1, 6) is formed and arranged to lock each said disk individually in engagement with the dubbing station, whereby each disk may

be unlocked separately if any audio data which has been copied from that disk to the removable solid state memory means (5) has been deleted from the solid state memory means.

25. A dubbing system according to claim 23 or claim 24, wherein locking and unlocking of the locking means is controlled by a processor means (6) of the dubbing system which is programmed to verify if audio data copied onto the solid state memory means (5) from a said optical storage disk has been deleted from the solid state memory means.

26. A dubbing system according to any preceding claim, wherein the system further includes deletion means for enabling a user to delete data stored in the solid state memory means.

27. A dubbing system according to any preceding claim, further including additional interfacing means formed and arranged for enabling the system to receive audio data, already in compressed format, from an external source.

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Application No: GB 9927393.0 **Examiner:** Guy Tucker
Claims searched: 1 - 27 **Date of search:** 15 February 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): G5R RGA, RGC, RHX

Int Cl (Ed.7): G11B 7/28, 20/00, 31/00

Other: ONLINE: JAPIO, EPODOC, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
	NONE	

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